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ABSTRACT

The recent phenomenon of the "returning adult" to colleges has raised concern regarding two implications: age decline in intellectual ability and loss due to lack of practice. Literature indicates slight impairment of the problem-solving function until the years of advanced age. The degree of impairment is related to factors of educational attainment and relevant life experiences. Research on learning reveals that (1) conditioning research is limited in its applicability to classroom learning since it has dealt exclusively with advanced age, (2) performance on measures of verbal learning declines at least slightly during middle age and more significantly after that, and (3) evidence of rigidity learning deficit does not seem impressive. The literature also indicates a significant age deficit in secondary memory. Difficulties associated with conducting meaningful research on adult cognitive development include lack of life-span research, problems in isolating the age variable, problem in separating the components of intellectual functioning, and applicability of research to the classroom. There seem to be two areas regarding needs of returning students which could be profitably investigated: specific skills required for classroom success and effects of noncognitive variables on intellectual performance. (YLB)

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REVIEW OF RESEARCH IN SELECTED AREAS OF ADULT COGNITIVE DEVELOPMENT: IMPLICATIONS FOR ADULT EDUCATION

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I. Introduction

The average college student of the 1980's will be considerably older than the student of the 1960's. This is because of the recent phenomenon of the so-called "returning adult," the person who has been away from a formal educational setting for a number of years and later returns to begin or resume a college career. Most of the older students on college campuses today are in young and middle adulthood, with an age span of approximately twenty-five to fifty. Few would be considered elderly. Yet, as Monge (1969) observed in his classic paper on learning in the adult years, many professors constantly listen to the concerns of older students about their "loss of learning ability," and the possibility that they will be unable to keep pace with eighteen- and nineteen-year-olds. What do these concerns imply? Actually there are two different sets of implications. The first is that there is an age decline in intellectual ability: intelligence, problem-solving, ability, memory, or the ability to learn. The second implication is that there is a loss due to lack of practice: having been away from school for a long period of time, the individual fears that he has lost certain study skills through disuse.

These two implications are considerably different from one another, even though they are often entwined in the mind of the student and in the mind of the professor. They may differentially affect the student's self-concept and motivation to achieve, and they may differentially affect the professor's set of expectations for the student as well as his educational philosophy in working with returning adults. For example, if there is an actual cognitive decline associated with age, then it would be pointless

to expect the same academic performance from an older student as from a younger one. Instead professors might be inclined to accommodate to the assumed age changes by altering their lecture styles and course requirements to suit the older learner. On the other hand, if there is no cognitive age decline, but only a lack of practice with academic materials, then special programs might be designed to re-acquaint the returning student with necessary academic skills.

For the life-span developmental psychologist interested in cognitive processes, the recent influx of returning adult students presents a stimulating challenge. Increasingly there is a need for answers to questions about cognitive change during adulthood. There is also increased concern about underlying assumptions of much of the past research, and about the adequacy of our methodology for studying genuine age changes.

What follows in this report is a) a review of the literature dealing with adulthood changes in intelligence, problem-solving, learning, and memory, b) a discussion of difficulties associated with conducting meaningful research in the area of adult cognitive development, especially as it relates to the classroom experience, and c) suggestions for further research.

II. Intellectual Development During Adulthood

A. Intelligence and Problem-Solving. It is difficult to determine whether intelligence stabilizes, declines, or continues to grow throughout the life-span, because intelligence apparently consists of many related factors and is manifested in many different ways. A convenient framework to use in discussing different

patterns of IQ change is Wechsler's (1955) distinction between verbal and performance subtests on the WAIS. Scores on the verbal subtests, including information, comprehension, arithmetic, vocabulary, and similarities maintain themselves very well across the life-span. Scores on the performance subtests, such as picture completion, object assembly, block design, picture arrangement, and digit symbol, begin to decline through middle and old age. The "verbal" stability and "performance" decline has been observed repeatedly in the research, so much so that Botwnick (1967) refers to it as a classic IQ pattern in adulthood.

Factor analysis of the verbal and performance subtests reveal that the verbal subtests rely heavily on the factor of verbal comprehension, or, roughly speaking, the ability to derive meaning from words. The performance tests, especially object assembly and block design, rely on a factor of nonverbal organization, described by Wechsler (1956) as "the capacity to organize discrete spatially perceived units into larger wholes or configurations" (p. 125). Both types of subtest involve general reasoning and memory factors.

There are those (Cattell, 1963; Horn and Cattell, 1966, 1967; Horn, 1970, 1978) who maintain that the WAIS verbal and performance subtests measure different forms of intelligence. Crystallized intelligence, tapped by the Verbal Tests, involves the ability to use previously acquired skills to solve a problem.

It includes vocabulary, general information, formal reasoning, and social skills. Horn and Cattell (1967) describe crystallized intelligence as "the extent to which one has appropriated the collective intelligence of his culture for his own use" (p. 111). Fluid intelligence, tapped by the Performance subtests, includes inductive reasoning, discrimination, figural relations, memory, and intellectual speed.

While crystallized intelligence continues to increase with age throughout adulthood, Horn and Cattell (1967) found age decrements in fluid intelligence even after the decade of the twenties, leading them to suggest that as a person ages he substitutes certain components of intelligence for others--accumulated wisdom for brilliance. Horn (1970, 1978) suggested that the fluid intelligence decrement might be explained by age-related "injuries" to the brain, or by psychological factors such as rigidity.

Green (1969) rejected the neurological argument, maintaining instead that the abilities involved in crystallized intelligence are more often practiced in daily life than are those involved in fluid intelligence. The difference, then, is in the frequency of usage and the consequent differences in meaningfulness of the test questions. It is an appealing argument that the older adult, even if he is only in his late thirties, is rarely called upon to use inductive reasoning or to test his span of apprehension. On the other hand, he constantly uses vocabulary, practical information about the world, and "social intelligence."

Any age decline in fluid intelligence or problem-solving must be interpreted with caution because of the difficulty of separating the age factor from the cultural factor. However, even if the decline is truly age-related, resulting from neurological deterioration in the organism rather than lack of practice, the loss of fluid intelligence would be a gradual one until the decades of advanced age--the late sixties, seventies and eighties. It would be difficult to argue that the typical returning adult student would be at a serious educational disadvantage because of a fluid intelligence deficit.

The research on problem-solving in adulthood presents an ambiguous picture. It would be fair to say that most of the studies point to a decline in problem-solving ability, but there is also evidence to the contrary. It is also important to note that problem-solving has not always been defined in precisely the same way. In describing the studies which follow, problem-solving will be seen as a combination of processes involved in the formation of ideas, the testing of the ideas for adequacy, and the accepting or rejecting of them on the basis of test results (Botwinick, 1973).

One of the most extensive life-span studies of critical thinking and problem-solving was carried out be Friend and Zubek (1958). They administered the Watson-Glaser Critical Thinking Appraisal Test (1952) to 484 persons ranging in age from twelve to eighty years. The test contains five sections: a) inference,

or the ability to draw appropriate inferences from a given statement, b) recognition of assumptions, c) deductive reasoning, d) interpretation, or the ability to distinguish between unwarranted generalizations and warranted probable inferences, and e) the ability to distinguish between strong and irrelevant arguments. All of the questions in the Watson-Glaser Test deal with practical everyday experiences.

Friend and Zubek found that there was an age decline in each of the five abilities measured by the test. While the decline curves were not identical for each ability, a general pattern emerged. Critical thinking developed rapidly at the end of the teen years, reached a peak in the mid-twenties, held until the middle thirties, and then began to decline.

The authors argued that most of the decline was probably associated with the factor of age alone because a) the tasks were highly motivating to all subjects, b) the practical real-life nature of the questions should have made them equally familiar to all subjects, c) performance was not timed, so the age decline could not be attributed to loss of speed, and d) the groups appeared to be fairly similar in terms of educational attainment (although this was not determined scientifically).

Upon further analysis, the authors discovered reasons to suggest that the age decline could be accounted for by a) decreased objectivity, a tendency toward more subjective, biased responding to the questions with age, and b) a decreased

flexibility of thinking with increasing age. The authors did not suggest, however, that age declines in critical thinking are inevitable. In fact, there was reason for optimism about this issue since individual differences in performance were striking: fully sixteen percent of the subjects in their sixties performed better on the tests than persons at the supposed peak of critical thinking ability.

In one of the better known studies of more specific problem-solving abilities, Bromley (1956) presented a modified Shaw test to subjects in four age groups (17-35, 35-51, 51-66, 66-82). The test, designed to assess creative thinking, consisted of four wooden blocks which the subjects were asked to arrange in any way they chose. There were fifteen abstract and clearly defined sequences in which the blocks could be arranged (e.g., according to weight, height, position of notch). These sequences, referred to as Grade A responses, are considered examples of sophisticated problem-solving approaches. There were in addition a large number of less sophisticated approaches which could be taken in solving the problem. There were forty-one possible Grade B responses, less well-defined and less obvious, sixteen Grade C responses, which were illogical, confused, and concrete, and finally five Grade D responses, which reflected a lack of understanding of the problem.

Bromley found a significant relationship between age and quality of response. Grade A and B responses decreased with age;

Grade C and D responses increased. Since the Shaw test is intended to measure the ability to explore a number of possibilities in problem-solving, the ability to abstract information from a situation, and the ability to be flexible in thinking, it would appear that these abilities begin to decline, even by the time an individual is in his late thirties and forties. Bromley himself (1956) related performance on the Shaw Test to the possession of Cattell's fluid intelligence.

The difficulty in separating age from cultural factors is exemplified by the fact that two other developmental studies which used the Shaw test did not confirm Bromley's findings. In the first, Welford (1958) found that there was indeed a significant age decrease in the quality of responses when groups of clerical and secretarial workers were compared; there was an increasing tendency toward concreteness with age. However, the decline did not occur to a noticeable extent among university professors. Similarly, Cijfer (1966), in a study of Dutch physicians, found no decrease with age in the tendency to use higher level abstract responses on the Shaw Test. Botwinick (1973) cites these studies as evidence for the importance of education as a factor in the tendency toward abstract or concrete approaches to problem-solving in the adult years. Presumably the better educated person is more often called upon in his daily life to deal with abstract issues. If, as Bromley (1956) suggested, performance on the Shaw Test is related to the possession of fluid intelligence,

the latter studies appear to substantiate Green's (1969) position that the loss of fluid abilities is related to lack of practice rather than to organic deterioration.

Wiersma and Klausmeier (1965) studied the effect of age on concept attainment. Well-educated subjects in three age ranges (20-24, 25-34, and 35-51) were asked to choose cards one at a time from a deck, with each card representing a particular object. The experimenter informed the subject that he was thinking of a concept and as each card was revealed, he said yes or no, indicating to the subject whether or not the card represented the concept he had in mind. The dependent measure was the amount of time the subject required to induce the concept.

A significant age change was discovered, with the oldest group taking longer to attain the concept than the younger ones. Again, abstract reasoning ability appears to be related to age, but again the cultural factor could be relevant. Wiersma and Klausmeier questioned the meaning of their own results, asking whether there is a true age decline or whether there is a "forgetting how to learn" by persons not as recently practiced in skills of this nature.

Brinley, Jovick, and McLaughlin (1974) studied concept acquisition in four age groups (22-34, 36-50, 51-65, and 66+) equated on educational attainment and vocabulary scores. The subject viewed three slides sequentially, each slide containing various letter groups. One letter was designated as "correct"

and each grouping was followed by a plus or a minus, indicating whether the correct letter was or was not contained in the grouping. The subject was required to solve the problem by determining which was the correct letter in each slide series, based on the positive or negative information he received.

The authors found a significant age decline in the ability to solve the problem. While the decline was steeper after the age of fifty, the 36 to 50-year-old group had a significantly poorer performance than did the 22 to 34-year-old group. It is difficult to determine the specific component of problem-solving which is related to age decline, but the authors obtained some clues: When the latter groupings were highly organized, the age decline was minimized. When they were low in organization, the age decline was more apparent. In other words, if a high level of structure is built into the problem to be solved, older persons benefit more than younger ones. If the structure must be provided by the person solving the problem, then the older individual is at a particular disadvantage. The authors concluded that there were age differences in reasoning performances associated with difficulties in encoding, storing, or utilizing information.

Arenberg (1968) tested concept attainment on groups aged 17-22 years and 60-77 years. His subjects were given a list of foods three at a time and asked to determine which of the foods was poisoned by examining the effect of the meal on a hypothetical

diner. For example, a diner died after eating a meal of coffee, lamb, and peas; a diner died after eating coffee, veal, and peas; a diner lived after eating coffee, lamb, and corn. Therefore, there is only one food which could have contained the poison: the peas. The problem is an example of reasoning from positive and negative instances, and Arenberg found that the elderly group did not perform as well as the younger group. However, the performance difference was not nearly as great as when Arenberg presented the same problem in abstract terms. That is, instead of foods, he used categories of form, color, and number. In the abstract version of the problem, very few of the older people could solve even one of them.

The Arenberg study suggests that there are age differences in problem-solving ability, but that these differences can be dramatically reduced if concrete and meaningful rather than abstract problems are used. The study does not offer an explanation as to why the differences exist in the first place, whether they are cultural or truly age-related. Finally, the study does not provide information about changes in concept acquisition across the span of the middle adult years.

In research on more complicated forms of problem-solving, the results are somewhat contradictory. Wetherick (1964) presented subjects in three age groups (21-30, 42-47, and 60-70) with a display containing four light switches, each of which could be set in three positions. The subjects were required to discover the

one arrangement of switches which would make a light on the panel go on. Wetherick found that not only was there no decline in performance with age, but that the group in their sixties were actually better than either of the younger groups.

In discussing Wetherick's findings, Botwinick (1973) observed that the failure to find an age decline may have been related to the fact that Wetherick's groups were matched in intelligence on the Progressive Matrices Test. If the ability to solve problems and the ability to perform well on an intelligence test involve the same cognitive processes, then the groups may have been equated on the variable under study. The failure to find an age decline is not surprising.

In contrast to Wetherick's results, Young (1966) found that a group of older people (54-76) do not solve complicated problems as well as a younger group (29-45), and this was despite the fact that she too had matched them for intelligence on the Progressive Matrices Test (Raven, 1956). She used the Logical Analysis Device (LAD) as her task, which involved learning a series of complex relationships between lights and buttons on a panel, and pressing the buttons in the correct sequence in order to make a center light go on. The older subjects performed poorly because they pressed the buttons inefficiently and were unable to apply a solution strategy which had been demonstrated for them. Frequently they became confused and repeatedly pressed the same three buttons, apparently in the hope that they might happen upon the

correct solution.

Using a similar apparatus, Arenberg (1974) tested three hundred men ranging in age from twenty-four to eighty-seven years. The men were tested twice with a span of six years between testings. This study, therefore, contained both a longitudinal and a cross-sectional design. In the cross-sectional analysis, performance on the task, which involved analyzing and synthesizing information in order to solve a problem, declined significantly with age. There was a significant correlation between age and the number of uninformative inputs. In other words, the reasoning of the older subjects was less efficient than that of the younger ones, with the most significant declines occurring after the decade of the fifties. The longitudinal analysis revealed no significant age changes in any of the groups under the age of seventy. For those over seventy, however, there was a significant decline in problem-solving ability. In summary, the Arenberg data suggest that there is a decline in problem-solving ability with age with highly complex problems, but that the decline is a gradual one until the sixties or seventies at least.

Conclusion: While it is difficult to draw simple conclusions from all of the literature on problem-solving, it is fair to say that impairment of this function is slight until the years of advanced age, and that the degree of impairment is related to factors of educational attainment and relevant life experiences.

There is no evidence to suggest that the increasing concreteness of the thinking of older people is a necessary consequence of the aging process. The abstract problem-solving skills of the typical returning adult student, aged twenty-five to fifty, should remain virtually intact.

B. Learning. A major difficulty in describing the results of research or learning in adulthood is that a distinction must be made between learning and performance. If an individual is unable to perform a given task, this may indicate that he has failed to learn the task, but it may also indicate that he has learned the task initially but is unable to perform because of factors such as a) loss of speed, b) memory loss, c) anxiety, d) lack of motivation, or e) distraction from other sources. In other words, ability to perform may indicate that learning has taken place, but failure to perform does not prove that learning has not taken place. If the non-cognitive factors influencing performance in the research on learning were equally significant at all age levels, then these variables would not have to be controlled for. However, there is much evidence to suggest that the performance of older learners is more affected by non-cognitive variables than is the performance of younger ones. The learning-performance distinction has been dealt with directly in much of the research discussed below. Research which ignores the distinction must be viewed as limited in that respect.

1. Conditioning. Research findings on conditioning in which different age groups have been compared are of limited usefulness to a discussion of the needs of returning adult students because a) there is relatively little research in this area, b) much of the research was done with animal rather than human subjects, and c) the applicability of research on the conditioned reflex to the classroom is, to say the least, unclear. However, some studies are worthy of mention because they may shed some light on the factor of loss of reactivity in later life.

In one of the earlier studies of conditioning with adults of different ages, Braun and Geiselhart (1959) conditioned a young group (18-25 years) and an older group (62-84 years) on the eyeblink response. Not only was it easier to condition the younger subjects, but it was easier to extinguish the behavior as well. The older persons took longer to associate the increasing brightness of a disc (CS) with a puff of air delivered to the eye (UCS) and it took them longer to forget the association once it had been made.

Similar results were obtained in later studies (e.g., Botwinick and Kornetsky, 1960; Kimble and Pennypacker, 1963; Solyom and Barik, 1965) with human subjects. Summarizing these data, Botwinick (1973) suggested that older persons are less reactive than younger ones. Whether this is a result of increased susceptibility to adaptation of reflexes, as sug-

gested by Kimble and Pennypacker (1963), lessened awareness of sensory cues, as suggested by Solyom and Barik (1965), or a general lowered arousal level is unclear. It is clear, however, that elderly human beings cannot be conditioned as easily as younger ones.

A similar pattern has been described in research on operant conditioning in rats (Denenberg and Kline, 1958; Battig and Grandjean, 1959; Goodrick, 1965). It would be fair to say, however, that the animal research has produced contradictory results, so that definite conclusions about operant or classical conditioning changes with age would be difficult to draw (Arenberg and Robertson-Tchabo, 1977). In more complex forms of learning, such as maze learning, older rats do not learn as well as younger ones (Goodrick, 1968, 1973b) and more frequently display behavioral rigidity by perseverating on incorrect responses, but the results of simple conditioning studies with rats are ambiguous.

Conclusion: As mentioned earlier, the conditioning research is limited in its applicability to the classroom learning situation, especially since it has dealt exclusively with changes of advanced old age, rather than early adulthood and middle age. It offers little which would be useful in a program of research on the classroom learning capabilities of young and middle-aged adults.

2. Verbal Learning. Most of the verbal learning research has

employed the paired-associate design, in which the subject is shown a list of word pairs one at a time, and then shown in sequence the first word of each pair by itself. The learning which is expected to occur involves the association between words in each pair, so that when the single words are later presented, the other half of the pair should be recalled.

The research on paired-associate learning has yielded consistent and unambiguous findings: performance on the paired associate task declines with age (Arenberg, 1965; Canestrari, 1963, 1968; Gilbert, 1941; Monge 1969; Monge and Hultsch, 1971). Typically these studies compared a young and an elderly sample, a design which is characteristic of much of the gerontological research. However, in two of the studies, (Canestrari, 1968; Monge and Hultsch, 1971) middle-aged people were also included. Canestrari (1968) found a linear decline in performance when he compared people in their thirties, forties, fifties, and sixties. Monge and Hultsch (1971) compared a group of twenty to thirty-nine-year olds (Mean age: 28.4) with a group of forty to sixty-six-year olds (Mean Age: 49.4 years) and found an age decline.

In attempting to explain why performance on verbal learning tasks declines with age, researchers have taken a number of different approaches. Some have argued that the decline is a direct result of loss of speed among older adults. Others maintain that the older adult does not use verbal or visual

mediators as effectively in learning as does the young adult. A third view, related to the second, is that older adults have forgotten many of the skills required for verbal learning tasks; they have lost the "set" to learn. Finally, non-cognitive factors must be considered in any meaningful discussion of changes with age in verbal learning.

Loss of Speed. A number of hypotheses linking age declines in paired associate learning to a loss of speed with increasing age have been suggested. Among these are that a) older people need additional time to inspect the materials to be learned, b) older people need additional time to recall the materials after they have been learned or c) both of the above. The technique for determining where a difficulty resulting from loss of speed might lie is to systematically vary the amount of time the stimulus materials are exposed (the inspection interval) or to systematically vary the amount of time allowed for a response when only the first word of the pair is presented (the anticipation interval). If a longer inspection interval serves to eliminate age differences in paired-associate learning, we might conclude that older persons learn as well as younger ones but take longer to do so. If longer anticipation intervals eliminate the age differences, then a logical conclusion is that initial learning is the same for young and old, but older persons need additional time to retrieve learned material from storage.

A number of studies in which either or both intervals have been varied (Arenberg, 1965; Canestrari, 1963, 1968; Monge and Hultsch, 1971) have produced a consistent pattern of results: Persons at all age levels benefit equally when the inspection intervals are lengthened, but there is a significantly greater benefit to older persons than to young ones when anticipation intervals are lengthened. In other words, a major reason for learning difficulty in middle-aged and older adults is that they need additional time when called upon to produce what they have learned.

Finally, it should be noted in discussing the speed factor in learning research that speed is not the only factor involved in the learning-performance deficit. Even when speed is completely eliminated and the individual is allowed to learn at his own pace, there is still an age deficit (Canestrari, 1963). The deficit is not nearly as great as in the experimenter-paced conditions, but it remains nevertheless.

Use of Mediators. Research into age differences in the use of verbal and visual mediators (e.g., Canestrari, 1968; Hulicka, 1965, 1966; Hulicka and Grossman, 1967) was stimulated by earlier work in verbal learning suggesting that word associations are easier to establish if specific mnemonic devices are used (Paivio, 1965a,b; Runquist and Farley, 1964). For example, two words might be connected verbally into a phrase: "child-match" could become "the child lit a match." This is a verbal

mediator. If the subject connected the words by means of a visual image, he would be using a visual mediator.

There is evidence to suggest that, while most young adults (68%) spontaneously use mediators in a learning task, most older adults (64%) do not (Hulicka and Grossman, 1967). There appears to be in later adulthood what Canestrari (1968) described as an "associative impoverishment." This is particularly true when the words to be associated are abstract rather than concrete (Rowe and Schnore, 1971).

Hulicka and Grossman (1967) and Canestrari (1968) were able to teach elderly persons to use mediators, with the result that their paired-associate learning scores improved considerably in both studies. Teaching young adults to use mediators did not affect their learning scores since, presumably, they had already been using such mnemonic devices.

It is intriguing to speculate on the reasons for mediation failure in late adulthood. Is it associated with physiological decline or with lack of practice? Such speculation is of little value, however, in discussions of the problems of returning adult learners, because the only developmental studies on mediation have been restricted to the extremes of the adult age range. Hulicka and Grossman (1967) for example, compared a group of high school students (Mean age: 16.1 years) with a group of persons of advanced age (Mean age: 74.1 years). The

mean ages of Canestrari's groups were twenty and sixty-two. It would appear that research into the spontaneous use of mnemonic devices in a learning situation might profitably be extended throughout the adult life-span.

Learning Set. Several studies have dealt with the concept of learning set in the adult years (Hultsch, 1969, 1971a, 1971b; Monge, 1969; Monge and Gardner, 1972; Monge and Hultsch, 1971). The concept of learning set was originally developed by Harlow (1948) to explain the ability of animals to transfer learning techniques from one task to another. The second task would be learned more quickly than the first because, even though the second task itself was unfamiliar, learning skills which had been effective in the first task could be applied to it.

Monge (1969) suggested that the adult who has been out of school for several years may have lost the set to learn academic material. Learning habits may have deteriorated because they have not been practiced in several years. The ability to take meaningful notes, for example, or the ability to read and study efficiently may be impaired because techniques of note-taking or reading textbooks may no longer be familiar to the learning. Two clear assumptions of Monge's learning set approach are that a) it is not the aging process itself which causes learning difficulties, and b) losses in learning ability can be overcome if the tools for learning are provided again.

There is some support in the literature for the view that providing learning sets for older adults eliminates or minimizes age differences in verbal learning. Monge (1969) had a group of women in their thirties and a group in their sixties learn six lists of paired associates, with both slow and fast inspection intervals. The findings were somewhat ambiguous. Surprisingly the older group at the slow pace was the best-performing group in the study. The older group at the fast pace performed worst. Learning set would be involved if performance improved across lists from the first to the sixth, because this would demonstrate that getting used to the learning situation (i.e., forming a learning set) resulted in increasingly better performance. Indeed, the older subjects at the slow pace did improve across lists, but the older group at the fast pace did not. Therefore, the learning set hypothesis was not fully proven.

In another investigation of the learning set hypothesis (Monge, 1972), twelve women in each decade from the twenties to the sixties learned three easy and three difficult paired-associate lists. Half at each age level learned the easy lists first and half learned the difficult ones first. There was only one age-related effect of the ordering of the lists: the women in their sixties were at a severe disadvantage when they switched from easy to difficult lists, whereas the younger groups were only mildly affected by the transition. The author

concluded that the acquisition of a learning set was orderly when the easy lists were presented first, but it was disrupted when the transition was from difficult to easy. Since only the elderly group was affected, however, it is difficult to apply the results of this study to learning problems of the typical returning adult student.

The two studies of learning set mentioned above were based on the assumption that a set would be acquired if time for practice were allowed. Other studies have taken a more direct approach to set acquisition. Hultsch (1969) presented lists of words to persons in three age groups (16-19, 30-39, 45-54) and then asked them to recall the lists. In one condition, no learning techniques were suggested. In a second condition, the subjects were told that organizing the words in some way would help them to remember them. In a third condition, the subjects were told to alphabetize the words as a learning aid. The young subjects performed better in all conditions than did the older groups, who did not differ from each other. In addition, all groups performed better under the alphabetization instructions, but the age-instruction interaction was not significant. The older groups were helped no more by the special instructions than was the younger one.

Hultsch (1969) reanalyzed his data, grouping the subjects into high- and low-verbal facility groups based on performance on a vocabulary test. For the high-verbal group, there were

neither age nor instruction differences. For the low-verbal group there was a significant age by instruction interaction. When no special instructions or only general instructions to organize the data were provided, the youngest group surpassed the two older ones in list recall. Under alphabetization instructions, all three low-verbal groups were equal. Apparently the provision of a learning set can increase the performance of older persons in a verbal learning task if the subjects are low in verbal skills. The highly verbal individuals probably used a verbal mnemonic device spontaneously.

In a similar study, Hultsch (1971) tested three groups of women, aged 20-29, 40-49, and 60-69. The sample was judged to be superior in both verbal ability and educational level. Half of the sample was given a deck of fifty-two cards, each with an English word on it, and were asked to sort the cards into not less than two or more than seven groups of their own making. The other half was told to inspect the cards one at a time. Later both groups were asked to recall as many words as possible. In the non-sorting condition, the youngest group recalled a significantly larger number of words than did the two older groups, who did not differ from one another. In the sorting condition, however, the youngest group differed only from the oldest group. The middle group did not differ significantly from the other two. Apparently the strategy of meaningfully organizing material to be learned facilitated the

learning of the list for the subjects in their forties, to the point where they no longer differed from a group of young adults. The use of organizational strategies benefited even a verbally superior group. Perhaps the material to be learned did not suggest a spontaneous mnemonic strategy, as may have occurred in the earlier Hultsch study.

The concept of age-related deficiencies in learning set is an appealing one because it appears that such deficiencies can be remedied if appropriate experiences are provided. These experiences might consist of simple practice with learning tasks, or they might consist of suggestions for meaningful organization of materials to be learned in order to facilitate later recall. The findings of the studies mentioned above and several others (see Monge and Gardner, 1972) do not provide simple answers, and it is not obvious that learning set deficiencies are solely responsible for learning difficulties in middle and especially later adulthood. At this point it is not even clear which cognitive "tools" are essential to success in college. In a sense, more is known about the consequences of inadequate learning sets than about the requirements for adequate ones.

Monge (1969) suggested that the learner in the laboratory (or the returning adult college student) might display three symptoms of learning set deficiencies. First, he might be confused, asking himself what he is doing in the learning

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Monge (1969) suggested that the learner in the laboratory (or the returning adult college student) might display three symptoms of learning set deficiencies. First, he might be confused, asking himself what he is doing in the learning

situation and what he is supposed to pay attention to. The learning may not be meaningful to him if he is unfamiliar with the total learning environment. Second, he might display symptoms of rigidity, persisting in ineffective approaches to learning and problem-solving because he knows no others. Third, he may not respond at all, unless forced to. In the verbal learning study, this is an omission error; in the classroom it might be perceived as passivity.

Non-cognitive Factors. There are a number of intangibles which influence a learning experience, such as anxiety level of learner, motive states, and willingness to cooperate, (Botwinick, 1967). These are related to task meaningfulness. It has often been noted in laboratory settings that older adults may be more influenced by task meaningfulness than are younger ones. For example, Kolicka (1967) observed that many older subjects simply refused to learn paired-associate lists, referring to them as "nonsense." Of course, the college classroom should be more meaningful than a research laboratory setting, but since the returning adult is unfamiliar with the classroom, the relevance of the experience for him should not be taken for granted.

Finally, the concept one has of his learning abilities and the support he perceives in the environment may influence learning. In a clever study of these variables, Ross (1968) presented young (18 to 26 years) and elderly (65-75 years)

adults with a paired-associate learning task. The instructions for the task were varied. In the supportive condition, the learners were told that the study was designed to analyze the characteristics of words, and that their actual performance on the task was of no concern to the experimenter. In the challenging condition, the learners were told that they were taking an intelligence test and it was very important that they do the best they can. Finally, in the neutral condition, standard instructions for a paired-associate learning task were provided.

Ross found that the young subjects learned equally well regardless of the instructions provided. The older subjects, however, were heavily influenced by the instructions. Those in the challenging conditioning took significantly longer to learn than did those in the supportive condition, while those in the neutral condition were midway between the other two. While the older subjects in the Ross study were of advanced age and therefore not typical of the adult college student, it is interesting to speculate on the effect on learning of a threatening vs. non-threatening perception of the learning environment. It is particularly interesting that the young were not intimidated by the challenge, whereas the elderly apparently were. It is clear that age differences in learning ability may be the result of non-cognitive as well as specifically cognitive factors.

Conclusion: To summarize the research on verbal learning in adulthood, performance on measures of learning declines at least slightly during middle age and more significantly after that. However, learning must be evaluated in the context of the total learning situation. Age-linked declines in speed of encoding and speed of recall need to be considered, particularly if learners are elderly. The likelihood of reliance on spontaneous mnemonic devices in learning should not be overestimated; some use them while others do not. The use of these devices is age-correlated, with older persons using them less frequently than younger ones, and, rather than being a necessary consequence of the aging process itself, this probably reflects an increasing lack of familiarity with learning tasks, lack of practice, and lack of recent contact with abstract materials.

3. Rigidity in Learning. Before leaving the subject of learning in the adult years, a comment must be made on the subject of rigidity. One of the more pervasive stereotypes about adult cognitive change is that with advancing age there is increasing behavioral rigidity: the older learner is set in his ways and has difficulty altering his behavior to fit new circumstances. According to the rigidity hypothesis, it becomes increasingly difficult with age to overcome the effects of prior learning. To use Monge's (1969) terminology, the possession of one learning set may interfere with the development of a new one.

In fact, the research on rigidity in adult learning is inconclusive. In a frequently-cited study, Kay (1951) tested persons in age decades from the twenties through the sixties on a serial learning task and found that older subjects displayed a tendency to repeat errors rather than change their behaviors. The object of the task was to learn a button-pressing sequence which would extinguish all of the ten lights on a panel. Whereas the younger subjects kept changing their sequence if it did not produce the desired result, older subjects tended to perseverate. The tendency to unlearn one's mistakes declined with age. Kay (1959) later observed that such perseveration occurs because habit patterns are too strong to be overcome, as in the case of a tennis player who knows his stroke is inefficient but is unable to correct it. The analogy breaks down, however, when one considers that the task used by Kay was probably no more familiar to the older subjects than it was to the younger. The old, therefore, had no greater opportunity to learn inappropriate habit patterns than did the young; it is unlikely that they had years of experience learning the relationships between buttons and lights on a panel, as a tennis player might have had years of experience developing an inefficient stroke.

In contrast to Kay's findings, Belbin, Downs, and Moore (1964) found that the ability to transfer paired-associate learning does not decline with age. In their study, a young

(14-15 years) and a middle-aged (40-52 years) group learned a list with the original stimulus words but different response words. If the ability to unlearn old behaviors declined with age, the older group should have had more difficulty with the second than with the first list, while the adolescent would not have been affected as much by the change in response words. In fact, the groups were equal in their learning of both lists.

Monge and Gardner (1972), in a major study of variables affecting learning in adulthood, administered a modified version of the Rokeach Dogmatism Scale (1960) to a large sample of adults ranging in age from twenty to seventy-nine. They found an increase in the dogmatism score, which they viewed as a measure of rigidity, after the decade of the thirties. The increase was gradual in the forties and fifties but more pronounced after that. This appears to suggest very clearly that rigidity increases with age.

However, Monge and Gardner carried out specific studies of adulthood rigidity on learning tasks as part of a major research project at Syracuse University, and here the findings were not so clear. One hundred thirty-eight women, ranging in age from the twenties to the late fifties learned a paired-associate list. For half of the women, the stimulus word was on the left side of the pair and for half it was on the right. It was hypothesized that learning a word association from left to right would be easier than learning from right to left

because left-to-right is the normal reading pattern in English. (A pilot study using college students had suggested that right-to-left was indeed more difficult.) According to the rigidity hypothesis, the older subjects, who had more firmly entrenched habits of reading from left to right, would experience greater difficulty in the right to left condition than would the younger ones.

Monge and Gardner found that the rigidity hypothesis was not supported. Women in their twenties did learn faster than any of the older groups, but there was no significant effect due to position of the response word. There were successively large discrepancies between the L-R lists and the R-L lists with increasing age, as was predicted, but these differences did not reach the level of statistical significance. (A further study led the authors to conclude that the left-right vs. right-left effect is not a reliable phenomenon, and is probably not a valid measure of cognitive rigidity).

Several studies using human subjects have found evidence of age-linked rigidity in perceptual and psycho-motor tasks. Botwinick, Brinley, and Robbin (1959) required subjects to write as slowly as possible. They observed that older persons had more difficulty with the task than younger ones, presumably because with increasing age there is an increasingly strong habit pattern of writing at a consistent tempo. Ruch (1934) found that elderly persons had more difficulty than

the young in tracking a target while observing their hand movements in a mirror. This involved a reversal of the normal direction of movement, and the reversal was more confusing to the young than to the old. Korchin and Basowitz (1956) presented on a screen a series of thirteen drawings. The first drawing was clearly a cat and the thirteenth was clearly a dog but the intermediate slides depicted a gradual process of transition from cat to dog. Subjects in two age groups (22-33 years and 65-85+ years) were asked to identify the animal in each picture, and it was found that the older subjects took longer to recognize the transition. While the younger group switched from cat to dog in the middle of the series, the older switched considerably later.

Conclusion: It is difficult to relate perceptual and psychomotor rigidity to the type of rigidity which might interfere with classroom learning, especially since subjects at various adult age levels were not included in these studies. It would seem that the only reasonable conclusion which can be drawn about rigidity in adult learning is the conclusion drawn by Botwinick (1973), who stated that "in general . . . the evidence of a rigidity learning deficit in later life does not seem impressive." (p. 246).

C. Memory. It is difficult to isolate the variable of learning from the memory variable because learning and memory are usually considered as stages in the process of acquisition-retention (storage)-

retrieval. Measures of learning, whether in the classroom or in the laboratory, invariably include a memory component, and many of the studies discussed in the previous section tested memory as well as initial learning. In much the same way, many studies discussed below focus on the process of encoding of incoming material as well as on retrieving it.

Memory can be thought of as the retrieval from storage of previously-learned material, and learning is an essential prerequisite for a meaningful test of memory change with age. In other words, a comparison of the pure memory ability of persons of different age groups assumes that learning has taken place equally in all groups. If older adults have not learned as well initially as younger ones, then one could hardly expect them to remember as well either.

Memory has usually been thought of as consisting of two or more stages. As described by Craik (1977), the typical stage models distinguished between short-term and long-term memory (STM and LTM), the former involving acoustic coding of verbal items within a span of twenty to thirty seconds after presentation, and the latter involving semantic encoding with no limits on the time span. Short-term memory is thought of as temporary storage, while long-term memory is more permanent. Thus, material encoded in short term memory will be lost rapidly because of decay or interference before being transferred to long-term storage.

While the STM and LTM distinction has been referred to extensively in the literature, Waugh and Norman (1965) argued that a more useful distinction is between primary and secondary memory (PM and SM). Primary memory involves retrieval of material which is still at the level of consciousness, because of the recency of its presentation or because it is in the process of being rehearsed. If items of information in primary memory are not rehearsed, they will soon be forgotten. Rehearsed items may or may not enter into secondary memory, which encompasses material beyond the level of the immediate consciousness.

The advantage of the primary-secondary memory distinction over the short-term/long-term distinction is that the former focusses more on memory processes rather than on time span (Craik, 1977). Thus, if a subject were asked to recall a list of words presented ten seconds earlier, advocates of the STM-LTM viewpoint would maintain that this is a test of short-term memory. PM-SM advocates would argue that it might involve either primary or secondary memory depending on the level of consciousness at which the subject was holding the material. To avoid confusion resulting from differences in terminology, it seems advisable to use Craik's (1977) approach--he speaks of short-term and long-term retention, referring strictly to the time between stimulus presentation and recall and not to process. We are interested here only in short-term retention, since typically it is short-term retention which is involved in a classroom learning situation.

Performance on measures of short-term retention declines significantly with age, with the decline due primarily to losses in secondary memory. Primary memory remains virtually intact throughout the life-span.

Short-term retention research typically consists of studies of dichotic listening and studies of memory span. In dichotic listening experiments, two lists of words, letters, etc. are presented simultaneously to the subject, one list to each ear. The subject is required to report all the material heard in one ear and then all the material heard in the second. The usual finding of these studies is that there are no age differences in amount of information remembered from the first ear (the first half-set) but significant age declines in what is remembered from the second ear (Clark and Knowles, 1973; Inglis, Ankus, and Sykes, 1968; Inglis and Caird, 1963; Mackay and Inglis, 1963). The decline in ability to recall the second half-set begins after the age of thirty and continues throughout life. An interpretation of why the second list is more difficult to recall was offered by Inglis, Ankus, and Sykes (1968), who suggested that since the second list had to be held in storage while the first was being recalled, it is a decline in efficiency of short-term storage which causes the age-related memory loss. Arguing against this position, Craik (1977) maintained that much of the second list was lost because it had not been perceptually analyzed in any great depth. He suggested further that the necessity of dividing one's attention, a

feature of the dichotic listening study, has a more serious effect on the learning and memory of older adults than on younger ones.

Studies of memory span involve the presentation of a list of words, letters, or digits with the requirement that the list be reproduced immediately after presentation. Memory span is a short-term retention task, but it requires both primary and secondary memory, since only about three words at a time can be handled in primary memory (Watkins, 1974) and therefore the remaining items must go into secondary memory.

The memory span research has produced contradictory results. In some studies no age differences were found. For example, Craik (1968a) compared young (23-35 years) and old (60-72 years) subjects on their ability to recall a list of meaningless digits: No age differences appeared. However, when the same subjects were tested on meaningful digits, the young were superior to the old. The author suggested that familiar digits are susceptible to coding, or chunking, and this helped the young more than the elderly. In other words, if no mnemonic strategy is readily available, the young are penalized as much as the old, but if it is possible to use a coding strategy, the young are more likely to do so than the old.

Craik (1968a) explained his findings in terms of the primary-secondary memory distinction. The digits in the meaningless list were held in primary memory and acoustically coded; the meaningful stimuli were coded into secondary memory. Retrieval from primary

memory involves a simple readout of coded traces, whereas retrieval from secondary memory is a more complex decoding of material, referring back to strategies originally used in encoding. Therefore, the experiment demonstrated age changes in secondary, but not in primary memory.

Other studies have found no age differences in immediate memory span, presumably because these studies tested primary rather than secondary memory. Bromley (1958) reported that digit span forward did not decline with age, although digit span backwards declined slightly. He noted also that auditory memory was impaired less than visual memory. Kriauciunas (1968) compared four age groups (25-34, 35-44, 45-54, and 55-64) and found no significant age differences in digit span.

Talland (1968) tested memory span in a variety of ways, sometimes finding age differences and sometimes not. Summarizing his series of experiments, he concluded that there is at least a slight decline in short-term retention across the life-span, with the magnitude of the decline dependent upon the conditions of testing. He noted also that the decline is not continuous, but seems to occur at critical stages, at about age forty and again at age sixty. Finally, even at an advanced age, the overall decline is still relatively slight.

The ambiguity of the memory span research findings is consistent with Craik's (1977) suggestion that there is little or no age decline in primary memory. If a subject is asked to repeat

immediately and verbatim what he has heard, without reorganizing it in any way, he relies on primary memory. He simply "echoes" the stimulus. If, however, the stimulus leaves his immediate consciousness, it must be encoded systematically into secondary memory or it will not be retrieved. It is obvious that it is not primary but secondary memory, the efficient use of the storage system, which influences the academic performance of the older adult.

Organization appears to be the key to secondary memory. The person must be able to a) spontaneously impose organization on stimulus material and b) rely on that organization when retrieving the stimulus from storage. With increasing age there is decreasing ability to do one or both of these. The older adult does not encode material in the organized fashion of the young adult, or he simply has more difficulty than the young adult in retrieving information from storage, or both. Some evidence for the age-linked difficulty in systematic encoding has already been presented. In the Craik (1968) study, for example, young and old subjects performed equally well on the recall of meaningless digits but the young surpassed the old when meaningful digits were used. In other words, when there was a possibility of encoding material in meaningful chunks, the young did so much more efficiently than the old. In the Hultsch study (1971) mentioned in the previous section, middle-aged and elderly subjects improved significantly in their recall of words printed

on cards when they were specifically instructed to organize the list. The specific instructions to organize did not help a group of young adults, presumably because they had already been organizing the list without being told to do so.

Schonfield and Robinson (1966) argued, on the other hand, that age losses in memory do not result from failure to encode material in an organized manner, but from failures to retrieve it. They presented two lists of twenty-four words consecutively on a screen to persons ranging in age from their twenties to their sixties. The subjects were asked to recall words from the list and to recognize words from the other. Recall scores declined linearly and significantly with age, but the recognition scores did not change at all. The authors suggested that age deficits are found primarily in the retrieval process rather than in the encoding, or acquisition, process.

Conclusion: Whether it occurs during the process of encoding information for storage or in the retrieval process itself, it is clear that there is a significant age deficit in secondary memory. It is clear too that the memory loss is not confined to the later years of the adult life span, but may begin in the fourth decade of life. The older adult a) does not encode learned material in such a way that it can be recalled easily or b) has more difficulty retrieving information once it has been stored, or c) both of the above. It is not at all clear, however, that these deficiencies are caused by the aging process itself. Instead, they

may result from lack of practice with memory tasks; using Monge's framework, the older adult may not have a "set" for "learning-in-order-to-remember." In classroom terms, he may be lacking good study habits. While the practiced student may routinely weave mnemonic strategies into his studying techniques, the less experienced student may not. Professors commonly hear returning adult students observe that they became so involved in the reading that they forgot to actually study the material in an organized manner.

There is reason for optimism, however, about memory loss in adulthood. When older adults have been provided with techniques for organizing material meaningfully, age differences in recall have been greatly reduced, (although not completely eliminated). It should be possible to provide returning adult students with the mechanisms for "learning-in-order-to-remember." There is reason to assume that they will be able to use these mechanisms effectively, and even to generalize them to other situations, although, surprisingly, the latter has been ignored in the research literature.

Finally, it is not being suggested here that memory loss in adulthood is caused solely by the loss of a "set" to remember. Undoubtedly there are neurophysiological factors involved as well, but these probably do not play a significant role until advanced old age.

III. Problems with Research on Adult Development

A. The Lack of Life-Span Research. Despite the proliferation of books and journal articles offered as investigations into cognitive changes across the life-span, there is actually very little genuine life-span research. In the typical cross-sectional study, a group of young adults, usually under the age of twenty-five, is compared with a group of elderly adults on a given task. It is unusual to find decade by decade comparisons. The assumption seems to be that intellectual changes do not occur between the twenties and the thirties or between the thirties and the forties, or that if they do occur across the years of young and middle adulthood, the changes are not meaningful. This may in fact be the case. However, it would seem that questions about intellectual development in young and middle adulthood need to be investigated empirically. Only then will we have truly life-span research.

B. Problems in Isolating the Age Variable. In a recent review of potentially dangerous assumptions of cognitive research on aging, Labouvie-Vief and Chandler (1978) discuss the difficulties of studying age changes uncontaminated by physical, social, and cultural factors. One of their basic arguments is that human development does not occur in a vacuum. There are many changes which a person undergoes as he grows older, and performance differences between age groups may reflect generational change or health factors rather than actual age changes.

The criticism that non-intellective variables have a contaminating effect on the age factor in cognitive research has usually been leveled against the cross-sectional design. However, the longitu-

dinal design is not immune from the same criticism (Kuhlen, 1963). Cultural changes have a significant effect on longitudinal research as well. It is likely that because of recent world events, Americans today have a better understanding of Middle Eastern politics than they did five years ago. However, it would be ludicrous to conclude that knowledge of Middle Eastern politics increases with age.

Another weakness of longitudinal studies, especially those involving elderly persons, is a high rate of attrition. Riegel, Riegel, and Meyer (1967) observed that not only did forty-five percent of their sample fail to participate in their second testing, but also the dropout rate was not random. The initially less capable subjects dropped out, leaving a stronger sample of survivors at the time of retest, and thereby calling into question the validity of the results.

Finally, in the longitudinal design, there is a danger of a test-retest practice effect, especially if the time between testings is relatively short (Wohlwill, 1973).

A number of innovative research designs have been described recently to study age changes in intellectual functioning, and these include the convergence method (Wohlwill, 1973), the cross-sequential and time-sequential designs (Schaie, 1965, 1970), and the retrospective method (Wohlwill, 1973). However, the simple cross-sectional design, with its inherent contaminating factors, still appears to be the most widely used design in the research literature on adult intellectual development.

Meaningful research into intellectual development during adulthood must successfully isolate the age factor from cultural, social, and physical factors which are not inherently related to age. Labouvie-Vief and Chandler (1978) maintain that this has rarely been done up to this point.

C. Difficulty in Separating the Components of Intellectual Functioning. If the intellectual system is functioning inefficiently, it is difficult to determine where the inefficiency is to be found. The information-processing approach views the intellect as a "black box," into which material is placed and out of which material is retrieved when needed. The actual mechanisms by which information is acquired, stored, and eventually retrieved are never fully known, since the researcher cannot see directly into the black box. If there is a breakdown in the system (e.g., a loss of efficiency in solving a problem), the breakdown may have occurred at the point of initial acquisition of information; the information may have been presented too quickly, the problem-solver may not have been alert or motivated to learn at the time the material was presented, or the information needed to solve the problem was too abstract or confusing to be properly registered. The breakdown may have occurred because, although the information was effectively registered, the problem-solver may have lacked the ability to encode the material, to place it into storage. Mnemonic devices and rehearsal strategies are techniques used to "hold" information which is newly registered. Upon initially acquiring a list of words to be recalled

at a later time, a learner may spontaneously sort them into categories. This organization increases the likelihood that the list will be stored efficiently and will be eventually recalled. Finally, it is possible that, even if information is acquired and stored efficiently, there will be a breakdown in the retrieval, or recall, process.

The difficulty, then, in studying developmental changes in intellectual functioning is that differences among age groups in performances suggest that there are differences somewhere in the information processing chain, but do not specify where the differences lie. In the section on memory, this difficulty was clearly exemplified. That there are memory losses across the span of the adult years is undeniable. Whether these losses occur because of faulty registration, inefficient storage mechanisms, or failure in actual retrieval is unclear.

D. Applicability of Research to the Classroom. Most of the research on age changes in cognitive development cannot be easily applied to the classroom situation. This is especially true of the research on learning which has usually involved paired-associate verbal learning, serial learning, or conditioning skills related to but hardly identical to learning in the classroom. The literature on problem-solving has measured performance on tasks requiring logical inference. While it might be desirable to encourage the development of such problem-solving skills in the college classroom, in reality a major requirement for the successful college student is the

ability to memorize large quantities of information. The research on memory points to age-related declines in short-term retention, but whether the deficit is in the storage or the retrieval process, or both, is not completely known. The classroom learning environment cannot be as carefully monitored as is the laboratory setting.

IV. Conclusions

Having reviewed much of the relevant literature in the areas of intelligence, problem-solving, learning, and memory development during adulthood, and having taken note of some weaknesses in the literature as a whole, it seems appropriate to draw overall conclusions. What does the research tell us about the capabilities and the needs of the returning adult student? Since the typical "older" student is between twenty-five and fifty, there is no reason to assume that his classroom difficulties are inevitable. There is no evidence to suggest that age will place limits on his intelligence, his ability to learn, to solve problems, or to remember. The older student may experience difficulty in learning abstract material and he may lack the ability to process information efficiently so that it can later be remembered. However, his difficulties probably result from lack of practice rather than from the process of aging itself.

Losses in the area of speed and memory do occur, of course, but research indicates that these are very gradual during the middle adulthood years. Memory deficits can be eliminated completely if the material to be learned and remembered is initially well-organized, and if

adequate time to respond is provided on examinations.

There is no empirical support for the notion that increasing cognitive rigidity is an inevitable consequence of aging, particularly in the middle years of adulthood.

This optimistic picture of the maintenance of cognitive functioning during adulthood should not lead educators to ignore the special needs of the older adult population. Many older adults have long been absent from settings which require abstract learning and problem-solving and the memorization of abstract material, skills which are often taken for granted by college professors who practice them regularly. Recent high school graduates have (presumably) been developing these skills continually throughout their years of schooling. While professors and younger students are practiced in academic skills, returning adult students are not. As a result the older student may appear anxious, a bit confused, and inefficient in his approach to learning and problem-solving. It is important that educators recognize that there is a skill component involved in academic performance. The older student does not need sympathy for his imagined cognitive handicap; he needs training in the skills required for academic success, and, until he has re-acquired the appropriate "learning sets," he may benefit greatly from additional emotional support.

V. Future Research Considerations

In general, the most obvious research need in the area of adult cognitive development is for genuine life-span studies. Comparisons of intellectual functioning which are restricted to young and elderly

adults are simply insufficient if we are interested in developmental change. It is somewhat disappointing to engage in a research review and to find so few studies which include decade by decade age comparisons.

On a more specific level, it seems that there are two areas which could be profitably investigated in a research program on the needs of the returning adult student: First, it would be useful to examine the specific skills required for classroom success, the specific components of the learning set. These are alluded to frequently: reading ability, good study habits, ability to take notes, ability to take tests. However, none of these have been isolated and studied experimentally in developmental research on adults. There is no reason why these factors should not be examined empirically. The following are rough examples of research designs for such studies:

1. Age differences in comprehension of written material. Written material of varying degrees of abstractness would be presented to subjects of different ages, who would be required to select the most important ideas contained in the passages. The independent variable could also be the amount of time elapsed since the subject was enrolled in a formal educational program. A variation on this design might include a training phase, to determine if the skill of deriving information from written material can be taught, and if the learning of this skill occurs with equal ease in all age groups.
2. The components of multiple-choice problem solving. An attempt

would be made to separate the actual skill of taking multiple-choice exams from familiarity with the material upon which the questions are based. For example, the subject might be told that alternative a is always correct. Given this information, he must determine which of the other alternatives could not possibly be correct. Using logical inference, the subject would have to realize that some alternatives on multiple-choice exams contradict each other, while others do not. It is this realization which enables the test-wise student to narrow down his choices, thereby increasing the likelihood of a correct guess even if he is unfamiliar with the course material.

Age differences in this task could be examined and, as in the previous design, a training phase could be incorporated to determine whether adults can be taught to take multiple-choice tests.

3. Age differences in note-taking ability as a function of organization of the stimulus material. Several short selections would be read to subjects in different age groups who would be asked to take notes on the material as they listen to it. The degree of organization of the material would vary. Some of the selections would be logically and concisely arranged while others would be lacking any cohesive organizational structure. The hypothesis would be that an age by organization effect would occur, with the older subject suffering more from the

disorganization than the younger one, who has mastered the technique of finding order in disorganized lecture material.

4. Finally, there seems to be a need for research into the generalizability of learning sets. For example, does training in the skills required for one type of classroom problem-solving generalize to other problems, other areas of study, or other classroom formats?

A second profitable direction for future research into adult cognitive skills considers the effects of non-cognitive variables (e.g., anxiety, motivation, expectation of success or failure) on intellectual performance. There are many approaches which could be taken in this topic area. Indeed, much has already been done, but it is usually not of a developmental nature. Research possibilities include studies such as those described below, dealing with the effects of expectation upon cognitive functioning:

1. The effect of varying the instructions on paired-associate learning. Two groups of subjects would be used in this study, one aged 18 to 21 and the other aged 30-45. They would be tested on a standard paired-associate learning problem, but half of the subjects in each age group would have inserted into the task instructions a sentence similar to the following: "We are interested in age declines in the ability to learn, and so we are testing a group of people your age and a group of younger people."

If expectation affects performance, the groups hearing

the special instructions should take longer to learn the list than the groups which have been set up to expect decline. This effect would probably show up only among the older students.

2. The effect of prior information about adult cognitive change on paired-associate learning. A paired-associate learning task would be administered to two groups of returning adult students, one of which has recently been exposed to a short lecture on adult intellectual change. The assumption of this study is that expectation of age declines may hinder performance of the research in the field and might produce in the older student a more optimistic outlook (and improved performance scores).

3. Other research on the effect of expectation of intellectual performance might deal with the expectations of faculty. Does a professor who expects intellectual deficits in his older students evaluate their classroom performance differently from the performance of his younger students? There are intriguing possibilities for research here, which must be formulated in greater detail.

In addition to the above, which are intended only as very rough off-the-top-of-the-head examples, there are a wide variety of areas into which future research might extend. It does seem, however, that the two general areas outlined above, the skills required for successful academic performance and the noncognitive factors influencing

learning, might be especially profitable to explore. The tendency in the past has been toward a separation between the laboratory explorations of the developmental research psychologist and the more applied work of educators and educational psychologists. Closer interaction between the two might result in a definite advance in our understanding of adulthood cognitive functioning, benefiting both the developmentalist and the educator. More importantly, it could be of tremendous ultimate benefit to the subject of the research--the returning adult college student.

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